

***Staphylococcus aureus* Resistant to Vancomycin — United States, 2002**

Staphylococcus aureus is a cause of hospital- and community-acquired infections (1,2). In 1996, the first clinical isolate of *S. aureus* with reduced susceptibility to vancomycin was reported from Japan (3). The vancomycin minimum inhibitory concentration (MIC) result reported for this isolate was in the intermediate range (vancomycin MIC=8 µg/mL) using interpretive criteria defined by the National Committee for Clinical Laboratory Standards (4). As of June 2002, eight patients with clinical infections caused by vancomycin-intermediate *S. aureus* (VISA) have been confirmed in the United States (5,6). This report describes the first documented case of infection caused by vancomycin-resistant *S. aureus* (VRSA) (vancomycin MIC ≥32 µg/mL) in a patient in the United States. The emergence of VRSA underscores the need for programs to prevent the spread of antimicrobial-resistant microorganisms and control the use of antimicrobial drugs in health-care settings.

In June 2002, VRSA was isolated from a swab obtained from a catheter exit site from a Michigan resident aged 40 years with diabetes, peripheral vascular disease, and chronic renal failure. The patient received dialysis at an outpatient facility (dialysis center A). Since April 2001, the patient had been treated for chronic foot ulcerations with multiple courses of antimicrobial therapy, some of which included vancomycin. In April 2002, the patient underwent amputation of a gangrenous toe and subsequently developed methicillin-resistant *S. aureus* bacteremia caused by an infected arteriovenous hemodialysis graft. The infection was treated with vancomycin, rifampin, and removal of the infected graft. In June, the patient developed a suspected catheter exit-site infection, and the temporary dialysis catheter was removed; cultures of the exit site and catheter tip subsequently grew *S. aureus* resistant to oxacillin (MIC >16 µg/mL) and vancomycin (MIC >128 µg/mL). A week after catheter removal, the exit site appeared healed; however, the patient's chronic foot ulcer appeared infected. VRSA, vancomycin-resistant *Enterococcus faecalis* (VRE), and *Klebsiella oxytoca* also were recovered from a culture of the ulcer. Swab cultures of the patient's healed catheter exit site and anterior nares did not grow VRSA. To date, the patient is clinically stable, and the infection is responding to outpatient treatment consisting of aggressive wound care and systemic antimicrobial therapy with trimethoprim/sulfamethoxazole.

The VRSA isolate recovered from the catheter exit site was identified initially at a local hospital laboratory using commercial MIC testing and was confirmed by the Michigan Department of Community Health and CDC. Identification

methods used at CDC included traditional biochemical tests and DNA sequence analysis of *gyrA* and the gene encoding 16S ribosomal RNA. Molecular tests for genes unique to enterococci were negative. The MIC results for vancomycin, teicoplanin, and oxacillin were >128 µg/mL, 32 µg/mL, and >16 µg/mL, respectively, by the broth microdilution method. The isolate contained the *vanA* vancomycin resistance gene from enterococci, which is consistent with the glycopeptide MIC profiles. It also contained the oxacillin-resistance gene *mecA*. The isolate was susceptible to chloramphenicol, linezolid, minocycline, quinupristin/dalfopristin, tetracycline, and trimethoprim/sulfamethoxazole.

Epidemiologic and laboratory investigations are under way to assess the risk for transmission of VRSA to other patients, health-care workers, and close family and other contacts. To date, no VRSA transmission has been identified.

Infection-control practices in dialysis center A were assessed; all health-care workers followed standard precautions consistent with CDC guidelines (7). After the identification of VRSA, dialysis center A initiated special precautions on the basis of CDC recommendations (8), including using gloves, gowns, and masks for all contacts with the patient; performing dialysis with a dedicated dialysis machine during the last shift of the day in an area separate from other patients; having a dialysis technician dedicated to providing care for the patient; using dedicated, noncritical patient-care items; and enhancing education of staff members about appropriate infection-control practices. Assessment of infection-control practices in other health-care settings in which the patient was treated is ongoing.

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Editorial Note: This report describes the first clinical isolate of *S. aureus* that is fully resistant to vancomycin. *S. aureus* causes a wide range of human infections and is an important cause of health-care associated infections. The introduction of new classes of antimicrobials usually has been followed by emergence of resistance in *S. aureus*. After the initial success of penicillin in treating *S. aureus* infection, penicillin-resistant *S. aureus* became a major threat in hospitals and nurseries in the 1950s, requiring the use of methicillin and related drugs for treatment of *S. aureus* infections. In the 1980s,

methicillin-resistant *S. aureus* emerged and became endemic in many hospitals, leading to increasing use of vancomycin. In the late 1990s, cases of VISA were reported.

Although the acquired vancomycin-resistance determinants *vanA*, *vanB*, *vanD*, *vanE*, *vanF*, and *vanG* have been reported from VRE, these resistance determinants have not previously been identified in clinical isolates of *S. aureus* (9). Conjugative transfer of the *vanA* gene from enterococci to *S. aureus* has been demonstrated *in vitro* (10). The presence of *vanA* in this VRSA suggests that the resistance determinant might have been acquired through exchange of genetic material from the vancomycin-resistant enterococcus also isolated from the swab culture. This VRSA isolate is susceptible *in vitro* to several antimicrobial agents, including antimicrobials recently approved by the Food and Drug Administration (i.e., linezolid and quinupristin/dalfopristin) with activity against glycopeptide-resistant Gram-positive microorganisms.

In 1997, the Healthcare Infection Control Practices Advisory Committee published guidelines for the prevention and control of staphylococcal infection associated with reduced susceptibility to vancomycin (8); plans to contain VISA/VRSA on the basis of CDC recommendations have been established in some state health departments. In the health-care setting, a patient with VISA/VRSA should be placed in a private room and have dedicated patient-care items. Health-care workers providing care to such patients should follow contact precautions (i.e., wearing gowns, masks, and gloves and using antibacterial soap for hand washing). These control measures were adopted by dialysis center A immediately following confirmation of the VRSA isolate. To date, there has been no documented spread of this microorganism to other patients or health-care workers.

Strategies to improve adherence to current guidelines to prevent transmission of antimicrobial resistant microorganisms in health-care settings should be a priority for all health-care facilities in the United States. *S. aureus* should be tested for resistance to vancomycin using a MIC method. The isolation of *S. aureus* with confirmed or presumptive vancomycin resistance should be reported immediately through state and local health departments to the Division of Healthcare Quality Promotion, National Center for Infectious Diseases, CDC, telephone 800-893-0485.

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